American Mineralogist, Volume 82, pages 557–570, 1997

Dislocation formation and albitization in alkali feldspars from the Shap granite

Martin R. Lee and Ian Parsons

Department of Geology and Geophysics, University of Edinburgh, West Mains Road,
Edinburgh EH9 3JW, U.K.

Abstract

Orthoclase-rich alkali feldspars in the Lower Devonian Shap granite, northwest England, contain two generations of albite-rich feldspar. These have partially replaced earlier exsolution microtextures consisting of albite lamellae (coarse semicoherent albite films and fine coherent albite platelets) in tweed orthoclase. The earlier generation of replacive albite-rich feldspar ($\sim Ab_{90}An_{9}Or_{1}$) occurs together with orthoclase-rich feldspar ($\sim Ab_{10}Or_{90}$) in veins that crosscut exsolution microtextures throughout grain interiors. This episode of recrystallization was mediated by magmatic fluids at ~410 °C (estimated from two-feldspar geothermometry) and was driven by stored elastic strain energy, which was relatively homogeneously distributed throughout the microtextures. The later generation of replacive albite-rich feldspar, which is restricted to grain margins and is compositionally pure ($Ab_{>99}$), was produced by magmatic-hydrothermal fluids at ~370 °C. This generation of albite-rich feldspar does not crosscut exsolution microtextures and has selectively replaced volumes of highly elastically strained feldspar surrounding edge dislocations along semicoherent albite films. Marked differences in controls of the localization of the two generations of replacive albite-rich feldspar by pre-existing exsolution microtextures indicate that significant numbers of edge dislocations developed along albite films after the first phase of fluid-feldspar interaction and associated albitization but before the second phase. This relation indicates that edge dislocations formed between 410 and 370 °C. These observations have important implications for understanding the factors that control the interaction of alkali feldspars with fluids both in cooling igneous rocks and in clastic sedimentary rocks during diagenesis.